Active Project (2013 - 2015)

Reduced Order Aeroservoelastic Models with Rigid Body Modes Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Complex aeroelastic and aeroservoelastic phenomena can be modeled on complete aircraft configurations generating models with millions of degrees of freedom. Starting from a freely supported version of the model, a two-step model reduction process is proposed to create aeroelastic models that include rigid body dynamics. In the first step, proper orthogonal decomposition at a set of flight conditions reduces the model order from millions to hundreds of degrees of freedom. In the second step, a linear matrix inequality further reduces the order and creates a linear parameter varying reduced order model. The model includes a trimmed and parameterized description of aeroelastic forces valid over a region of the flight envelop. The same model can be used for rapid simulation and for linear parameter varying flight control design. Feasibility of this two-step process has been demonstrated in the Phase I work and a plan has been developed for a prototype implementation. Specific improvements to the rigid body model, technical risks in the development effort, and a risk reduction plan have been identified. An X-56A vehicle model will be developed and then used to demonstrate the model reduction process and to demonstrate applications including a linear parameter varying flight control system.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: The Reduced Order Aeroservoelastic Models with Rigid Body Modes technology will increase the technical readiness of methods that can be used by NASA to support Aeronautics Research. The proposed work addresses development of efficient methods to generate mathematical models of flight vehicles currently employed in NASA research projects such as the X-53 and X-56A for performing vibration, aeroelastic, and aeroservoelastic studies. This includes design methodologies that encompass CFD

Reduced Order Aeroservoelastic Models with Rigid Body Modes

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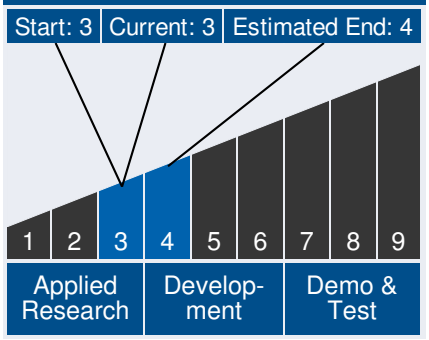
Technology Maturity



Management Team

Program Executive:

- Joseph Grant

Program Manager:

- Gary Jahns

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steady and unsteady aerodynamics, flexible structures, and active control systems. The work will use existing methods that predict aeroelastic phenomena and complex steady and unsteady aerodynamic flow phenomena, especially in the transonic speed range. The tools, methods, and algorithms developed in the Phase I effort can be marketed to both NASA and non-NASA customers as they are applicable to vehicles such as the X-53, F/A-18C, and X-56A.

To the commercial space industry:

Potential Non-NASA Commercial Applications: The innovating firm (Systems Technology, Inc.) has long standing relationships with numerous manufacturers of both commercial and military aircraft. Specifically, the firm has long standing relationships with numerous Boeing personnel at both the Military and Commercial Airplanes divisions, as well as within Lockheed Martin's X-56A program. Furthermore, the firm has participated in research efforts both as a lead contractor and subcontractor with these entities. Beyond industry there are potential post applications within the US military. The innovating firm is aware of specific interest within the US Air Force for aeroservoelastic simulation capability in concert with active control. Because of the demands of aeroelastic analysis and testing at the Air Force Flight Test Center at Edwards AFB and other military facilities such as the Air Armament Center at Eglin AFB and the Naval Air Warfare Center Weapons Division at China Lake, the capabilities can aid in flight test analysis, assessment and safety.

Management Team *(cont.)*

Project Manager:
- Martin Brenner

Principal Investigator:
- Peter Thompson

Technology Areas

Primary Technology Area:
Software Modeling and Model Checking (TA 11.2.1)

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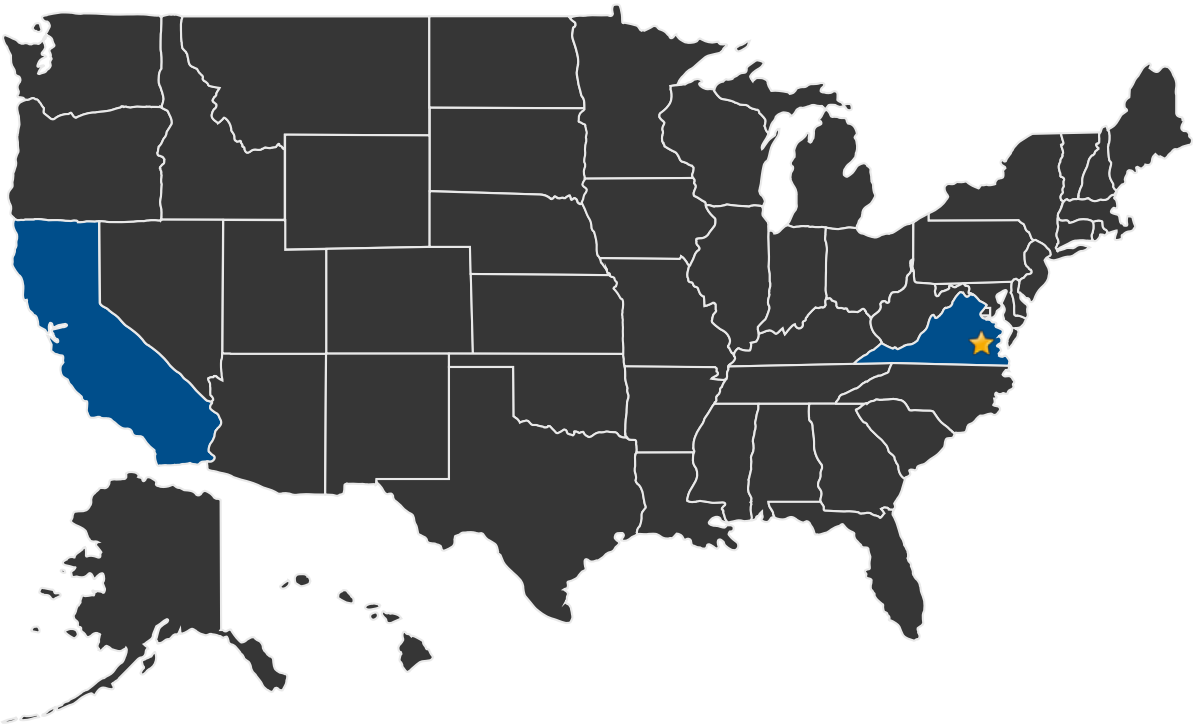
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Langley Research Center

Other Organizations Performing Work:

- Systems Technology, Inc. (Hawthorne, CA)

PROJECT LIBRARY

Additional Images

- Project Image
  - (This image is a .tif file. Please visit http://techport.nasa.gov:80/file/3559 to download this image to view it.)

DETAILS FOR TECHNOLOGY 1

Technology Title

Reduced Order Aeroservoelastic Models with Rigid Body Modes